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AMMUNITION AND EXPLOSIVES

Army Test and Evaluation Command
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13. ABSTRACT

Describes a method for evaluation of ammunition and explosives functional performance characteristics. Discusses preparation for test, facilities, and equipment required. Provides procedures for initial inspection, initial performance, tropic storage, transportation, handling, emplacement, functional performance, maintainability, and safety. Identifies data required and specifies analysis methods. Applicable to artillery and small arms ammunition, ammunition components, demolition materiel, mines, and pyrotechnics. Limited to field testing in the tropics.

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AMMUNITION AND EXPLOSIVES

SECTION I
GENERAL

1. Purpose and Scope.

a. Summary. The testing techniques described in this Test Operations Procedure provide a method of evaluating the capability of ammunition and explosives to function effectively during or after exposure to the elements of the wet-warm, wet-hot climatic categories, as specified in AR 70-38 (appendix). This document describes the test procedures to which the test item is subjected in determining suitability for use in the humid tropics. Test items to which it applies are artillery and small arms ammunition, ammunition components, demolition materiel, mines, and pyrotechnics. Standard subtests and objectives are listed below.

(1) Initial Inspection - Determine physical condition, completeness, and suitability for initiating testing.

(2) Initial performance - Establish initial performance characteristics.

(3) Tropic storage - Evaluate the capability of the test item to withstand static exposure to the tropic environment.

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(4) Performance - Determine the capability of the test item to function satisfactorily when employed under tactical (simulated) conditions encountered in a tropic environment.

(5) Maintenance - Evaluate maintenance characteristics of the test item and suitability of the maintenance test package for use in a humid tropic environment.

(6) Safety - Determine if the test item is safe for storage and use in a humid tropic environment and confirm the safety release.

b. Limitations. This TOP covers field testing. No instructions are provided for simulated environments. Procedures are limited to tests of ammunition and explosives that would require exposure to those environmental conditions described in AR 70-38, Section II, paragraphs 2-7 and 2-8 (appendix) and TOP 1-1-008 (appendix). The procedures set forth do not constitute a complete and detailed test plan. A detailed test plan can be developed using the procedures in this TOP, the test directive, the Materiel Needs documents, the commodity Materiel Test Procedure or TOP, and related references. Sample size should be developed in consultation with a statistician. Duration of storage will be specified in the test directive.

2. Basic Information.

a. Background. New materiel developed and produced for the United States Army must perform satisfactorily in all of the world's environments. The warm temperature and high humidity of the tropics combine to produce heavy vegetation and large varieties of microorganisms, insects, and animals. All of these contribute to the deterioration of materiel. Therefore, tropic tests are required to evaluate suitability when an item is intended for use in a tropic environment. A detailed discussion of the environmental effects of the tropics is found in TOP 1-1-008 (appendix).

b. Required Equipment and Facilities.

(1) Secure storage area

(2) Firing range or grid

(3) Test equipment (microphones, rangefinders stop watches and timers, event recorders, circuit testers, etc.)

(4) General and special tools for inspection or repair of the test item

(5) Cargo vehicles

(6) Still and motion picture, and video instrumentation systems

SECTION II
TECHNICAL PRESENTATION

3. Preparation for Test.

a. Conduct a review of the applicable requirements in the Materiel Needs documents. Review the guidance and objectives of the test directive.

b. Based on the review in paragraph a, above, determine whether the test plan requires any changes. If changes are required, prepare change notice in accordance with TECOM Regulation 70-24 (appendix).

c. Prepare test officer's logbook, data collection sheets, and personnel and support requests. Prepare detailed test schedule and submit request for range clearance.

d. Select test equipment and record nomenclature, serial numbers, accuracy, calibration requirements, and date of last calibration.

e. Review the safety release, applicable safety SOP, and range regulations. Prepare adequate safety precautions for personnel and equipment (paragraph 4f, below).

f. Record the grade, MOS, background, and training of all test personnel. Ensure that test personnel are properly trained and briefed on the test objectives, test item characteristics, safety precautions, and data collection techniques.

4. Test Conduct.

a. Initial Inspection.

(1) Visually inspect and record the condition and identification marking of all packages. Record packaging level in accordance with Military Standard 794B (appendix), as applicable.

(2) Mark the container and/or item with identifying code number.

(3) Subject test and control items, components, and accessories to a visual inspection to determine the existence of any damage or defects. Photograph as appropriate.

(4) Correct damage and defects in accordance with the applicable manual. If corrective action cannot be taken, remove item from test.

(5) Record the following physical characteristics as applicable:

(a) Exterior dimensions (length, width, diameter, etc.)

(b) Weights of the test item, components, and accessories

(c) Color, to include presence of reflecting or shining surfaces

b. Initial Performance Test - This supporting test will be performed only if enough test items are provided to allow a sample of sufficient size to provide statistically valid data.

(1) Randomly select a representative sample of test items and subject to functional testing using the procedure in paragraph d, below. This sample will be used to establish initial performance and provide a basis for comparing subsequent test data.

(2) Poor performance may indicate damage or defects not detected during the initial inspection. Establishing this before the storage phase of testing can save considerable time and expense.

(3) This subtest will aid in evaluating data collection methods and training of test personnel.

c. Tropic Storage. Test item storage will be consistent with normal procedures for the test item and its packaging. Storage area and condition will be based on the security, the Materiel Needs, and AR 70-38 requirements, but generally will simulate typical storage conditions.

(1) Place the packaged test item in the area designated for the type of storage. Install any special instrumentation requirements.

(2) Record the meteorological conditions at or near the storage site. When items are stored under a tent-type cover, temperature and relative humidity should also be recorded under the cover.

(3) Inspect the packaging of the test item periodically (preferably at 30-day intervals) for deterioration and/or damage. Test items stored in resealable packaging should be inspected visually for corrosion and/or damage.

(4) Photograph the storage site, test item storage configuration, and instrumentation array.

(5) Upon completion of the storage period, visually inspect each test item for damage and perform operational checks to verify operation.

d. Performance. The performance subtest can as a rule be divided into three areas of prime concern, i.e., transportation and handling, emplacement, and functioning.

(1) Transportation and handling. The test items will be loaded on vehicles organic to the using activity. Test participants will be those normally assigned to the type of activity requiring these kinds of munitions. This subtest will vary according to the nature of the mission and type of transport required.

(2) Emplacement. This subtest applies to items which are emplaced for undetermined periods of time prior to functioning. It is applicable to antitank and antipersonnel mines, cratering and demolition charges, trip flares, and other similar items.

(a) Emplace the items according to designated use and conceal according to standard field practices in Field Manual 5-20 (appendix).

(b) Use various terrain conditions (mud, hillside, etc.) available. Exposure will generally cover a period of approximately 30 days. At the conclusion of the exposure period visually inspect and check operational characteristics of the test items prior to functioning (where applicable).

(c) Ensure that emplacement sites are clearly marked and secured to prevent entry by unauthorized personnel.

(d) Photograph the exposure site at time of emplacement and prior to functioning.

(3) Functioning. All functioning tests will be conducted under prevailing meteorological conditions. The test officer will insure that a safety release has been received from TECOM, that safety requirements are adhered to, and that all personnel are familiar with the safety precautions.

(a) Unpack test items which have been left in containers.

(b) Visually inspect all unemplaced test items. Emplaced test items should be left undisturbed except for a randomly selected representative sample which should be exposed, inspected, and reemplaced.

(c) Photograph the functioning site, firing configuration, and instrumentation setup.

(d) Function emplaced test items at the emplacement site by application of initiation load (electrical, pressure, pressure release, etc.). To the greatest extent practical, functioning should be accomplished by test participants who would normally use the munitions in the field.

e. Maintenance (TECR 750-15, appendix).

(1) Required maintenance will be performed by personnel of the appropriate MOS. Maintenance will be accomplished using the procedures and tools specified in the manual.

(2) The adequacy of the maintenance instructions will be evaluated by observation and interview of test participants.

f. Safety.

(1) Prepare safety SOP which includes:

(a) Safety procedures

(b) Safety precautions

(c) Protection equipment and location

(d) Emergency procedures

(e) Reference to applicable safety documents (e.g., safety releases, AMC safety regulation, etc.)

(2) Inspect all test items for possible hazardous conditions (appendix).

5. Test Data

a. General. Prepare test officer's logbook containing a list of critical test occurrences (in sequence) pertinent remarks and observations (not included on data sheets) concerning the test item or test procedures. The logbook will also include:

(1) References to pertinent correspondence by file code and organization (e.g., 1309-11, STETC-TD-P, DF, subj: Met Conditions, 12 July)

(2) Description of the test item and components

(3) Photographic proof sheets

(4) Notations of personnel, support, and range requests

(5) Nomenclature, serial numbers, accuracy and calibration date of special instrumentation and test equipment

(6) List of test personnel with rank, job, brief background, and training of each

(7) Data sheets or reference to location

b. Initial Inspection. Record the following:

(1) Date, location, and personnel

(2) Condition and level of packaging

(3) Code numbers assigned

(4) Record markings and labeling to include:

(a) Lot number

(b) Manufacturer and location

(c) Date of manufacture

(d) Legibility and condition

(5) Record any damage and/or defects noted and action taken to correct.

(6) Record physical characteristics to include:

(a) Exterior dimensions (length, width, diameter, etc.)

(b) weights of test items and components

(c) Color and notation of any reflecting surfaces

(7) Take applicable photographs

(8) Record adequacy of instructions and any inadequacies

c. Initial Performance. Refer to paragraph e, below.

d. Tropic Storage. Describe and/or record the following:

(1) Storage conditions (including photographs)

(2) Special [illegible]

(3) Meteorological conditions (temperature, relative humidity, rainfall, and solar radiation) NOTE: Meteorological data requirements are determined on a case-by-case basis. Normally, the research meteorologist will determine the need for obtaining any special meteorological requirements beyond those that are routinely obtained at test sites.

(4) Date of inspections and personnel conducting inspection

(5) Inspection results including:

(a) Evidence of deterioration and/or damage

(b) Location of deterioration and/or damage

(c) Probable effects

(d) Any corrective action taken

e. Performance. Record all operational checks performed to determine operational condition after storage.

(1) Transportation and handling. Record the following:

(a) Date and location

(b) Item code numbers

(c) Personnel including function performed (driver, munitions handler, forklift operator, etc.)

(d) Type of vehicles and mileage

(e) Course description and/or maps

(f) Speeds

(g) Loading and unloading times

(h) Meteorological conditions

(i) Comments, interview and/or questionnaire results

(j) Inspection results

(k) Photographs

(2) Emplacement. Record the following:

(a) Date and location

(b) Item code numbers

(c) Soil description including type, chemical analysis, water content, Atterburg Limits

(d) Meteorological data

(e) Personnel

(f) Time to emplace and conceal

(g) Photographs

(h) Inspection results

(i) Comments, interview and/or questionnaire results

(3) Functioning. Record the following:

(a) Date, time, and location

(b) Item code numbers

(c) Personnel

(d) Type instrumentation and special equipment

(e) Meteorological data to include wind speed and direction at time of functioning

(f) Malperformance, variation in range, velocity [illegible], and order of functioning

(g) Soil analysis results

(h) Photographs

(i) Inspection results

(j) Comments, interview, and/or questionnaire results

(k) Type or initiation load

(1) Vegetation description

f. Maintenance. Record the following:

(1) Maintenance required to ensure serviceability

(2) Name and MOS of personnel performing maintenance

(3) Comments, interview and/or questionnaire results concerning the following maintenance aspects:

(a) Ease of performing

(b) Special skills required

(c) Special tools required

(d) Adequacy of instructions

(e) Photographs

g. Safety. Record the following:

(1) Inspection results

(2) Applicable data required by MTP 4-3-514 (appendix)

(3) Comments and observations pertaining to unsafe conditions and procedures

(4) Adequacy of safety instructions

6. Analysis

a. General. In general, the Materiel Needs documents dictate the degree of detail necessary for preparing an analytical plan; therefore, this analysis section is general and further guidance must be obtained.

b. Initial inspection

(1) Determine if the level of packaging is suitable for overseas shipment.

(2) Determine if the items are in or have been restored to a suitable condition for testing.

(5) Subjectively determine if the instructions are adequate for proper testing.

(6) Compare the weights and dimensions of the test items and components to the physical characteristics criteria in the appropriate technical documents. If a confidence interval statement pertaining to weights and dimensions or to their variability is desired, computations can be made using one of the appropriate statistical routines in AMC Pamphlet 706-100 (appendix). When reliability is associated with an item meeting or exceeding a given characteristic, the binomial distribution should be used.

c. Initial Performance Test. Refer to paragraph e, below.

d. Tropic Storage. After the storage phase, determine if the items are suitable for the performance test. If they are not, it must be stated that the test items are not suitable for use in a humid tropic environment giving appropriate supporting data as described in paragraph 5c. If the test items are determined satisfactory for performance testing, use the data collected from the initial performance and performance subtests to ascertain if any degradation in performance has resulted from a storage phase.

e. Performance Analysis. Performance is divided into three areas of prime concern, i.e., transportation and handling, emplacement, and functioning.

(1) Transportation and handling. A subjective analysis should be made to determine if the test item can be transported and handled without degradation to the item and/or components.

(2) Emplacement. A subjective comparison can be made from before and after test results to determine if proper emplacement and concealment of the test items have been maintained throughout the emplacement period. This analysis should be performed for each type of terrain condition (mud, hillside, etc.).

(3) Functioning. Reliability for proper functioning can be evaluated on a "go, no-go" basis using the cumulative form of the binomial distribution. For failed items, particular emphasis should be placed on proper determination of causes of failure (e.g., tropic environment).

f. Maintenance. A subjective analysis will be made of the adequacy of the maintenance instructions and requirements for special tools and

skills from comments of the test participants and interview and/or questionnaire results. Information for more detailed report, as set forth in the appropriate technical documents, can be obtained from TECOM Regulation 750-15 (appendix).

2. Safety. Any safety problem areas will be analyzed car fully as to the cause and prevention. Adequacy of safety instructions will be evaluated.

Recommended changes to this publication should be forwarded to Commanding General, US Army Test and Evaluation Command, ATTN: AMSTE-ME, Aberdeen Proving Ground, Maryland 21005. Technical information related to this publication may be obtained from the preparing activity (Commanding Officer, US Army Tropic Test Center, ATTN: STETC-OO, Fort Clayton, Canal Zone). Additional copies of this document are available from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314. This document is identified by the accession number (AD No) printed on the first page.

APPENDIX
REFERENCES

1. AR 70-38, "Research, Development, Test, and Evaluation of Materiel for Extreme Climatic Conditions."
2. MIL STD 794B, "Parts and Equipment Procedure for Packaging and Packing of "
3. FM 5-20, "Camouflage."
4. AMCR 385-12, "Life Cycle Verification of Materiel Safety."
5. AMCP 706-110, "Engineering Design Handbook."
6. TECR 70-24, "Documenting Test Plans and Reports."
7. TECR 70-23, "Equipment Performance Reports (EPR's)."
8. TECR 385-6, "Verification of Safety of Materiel During Testing."
9. TECR 750-15, "Maintenance Evaluation During Testing."
10. TECOM Memo 70-24, "Processing Test Directives, Test Plans and Reports."
11. TOP 1-1-008, "Tropic Environmental Considerations."
12. MTP 2-4-003, "Wheeled, Tracked, and General Purpose Vehicles."
13. MTP 4-3-514, "Safety Hazards."
14. MTP 4-4-001, "Desert Environmental Test of Ammunition and Explosives."
15. MTP 8-4-003, "Chemical Equipment."
16. MTP 10-3-500, "Preoperational Inspection and Physical Characteristics."